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AUTHOR Civretta, Adeline E.
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ABSTRACT

A study was conducted to determine whether a significant correlation exists between developmental age and the concept of conservation. The hypothesis was that if developmental age and the concept of conservation are related, then stages of understanding conservation will increase as developmental age increases. Ss consisted of 30 primary children from a school using placement based on Gesell developmental levels. Ss were tested on a one-to-one interview basis with six Piagetian tasks concerning conservation of quantity and the Gesell Developmental Examination, which consisted of an initial interview, paper and pencil tests, right and left tests, form tests, naming of animals, concluding interview, and examination of teething progression. A relatively high relationship was found to exist between the two variables, but not high enough to use for predictive purposes between the two instruments. Uses of the instruments are discussed, and it is recommended that the curriculum for primary children even in a developmental-placement school be highly individualized. (KM)

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A STUDY OF THE RELATIONSHIP BETWEEN GESELL'S DEVELOPMENTAL AGE AND PIAGET'S CONCEPT OF CONSERVATION

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Adeline E. Civretta

INTRODUCTION

Schools are presently searching for better measurements of individual readiness for specific levels of instruction. For many years educators have used intelligence tests to provide measures for predicting school achievement and at times for class placement. During the last decade the Gesell Developmental Examination has also been used in some schools for class placement. Currently, Piagetian tasks are being widely examined for application to school situations. Of interest to educators would be studies examining the relationship between different indicators of child development. One such study is reported here.

Arnold Gesell, founder of the Gesell Institute of Child Development, and his staff have produced material over four decades which describes the theory of developmental, or behavioral, age; and the procedures for establishing their validity. Gesell postulated that behavior is patterned and develops in predictable stages (Gesell and Amatruda, 1945, 173-194) or "degrees of maturity." (Gesell and Ilg, 1946, 19-20) Although no two individuals are exactly alike, all

normal children tend to follow a general ground plan which is characteristic of the species and the cultural group. (Gesell and Ilg, 1943, 72) The general course of development is similar for boys and girls although girls mature somewhat more rapidly and earlier. (Gesell and Ilg, 1946, 19-20)

Over a period of forty years, Gesell and his staff minutely observed and recorded on film the behavior of hundreds of children as they grew from infancy to 5, 10, 16 years of age. From these observations, normative patterns of behavior were charted and described, and tests were selected which defined the developmental ages for children. (Gesell, et al, 1940; and Gesell and Ilg, 1946) These tests used primarily at the clinic were later revised and standardized for school use by Ilg, Ames and Appel. (Ilg, Ames, and Apell, 1965, 62-91) Now known as the Gesell Developmental Examination, it is a battery of graded behavioral tests comprising primarily eye-hand coordination and verbal tests. It is administered to an individual child by a trained examiner. Scores are expressed in terms of developmental ages based upon sequential characteristic behaviors for each test. (Ilg and Ames, 1964)

Jean Piaget, of Switzerland, is currently recognized as one of the most important developmental psychologists. From about 1940 onwards, his clinical techniques and observations of children have led him to generate an extensive theory of mental development. His research is important to educators because he has shown that the relationship between experience and mental development is a crucial aspect in the total development of the child.

Piaget describes mental growth as proceeding in an invariant order of stages which he has named the sensory-motor, pre-operational, concrete operational, and formal operational stage. (Flavell, 1963, 164-236) He has theorized that stage-progression is dependent upon the interaction of maturation, experience, social transmission, and equilibration which sets the limits and determines the character of what can be learned during that stage. (Almy, 1966, 20-22; and Duckworth, 1964, 172-175) To determine the stage at which a child is functioning, Piaget has noted the mental problems the child is able to solve and the mode of thinking that he uses. The problems of conservation, for example, have come to be a landmark in his theory. For Piaget, the attainment of such ability marks the transition from the predominantly intuitive thought of the pre-operational stage to the more logical thought of the concrete operational stage. (Sigel and Hooper, 1968, 3)

In conservation tasks, an individual child is presented with two different but equal quantities of material (two balls of clay, two glasses filled with liquid) and is asked whether the two have the same amount. After the child agrees that this is the case, one of the quantities is transformed (a clay ball is rolled into a sausage, a glass of water is poured into a taller thin glass) and the child is asked again whether the two have the same amount. (Piaget, 1965, 243) Responses are based upon an understanding of the constancy of the material.

Piaget's results indicated that the child's ability to conserve is arrived at gradually, and that a period of non-

conservation is followed by a transitionary period of perceptual domination, finally progressing to a complete stage of conservation. (Almy, 1966, 34)

The Research Problem

The study reported here was designed to determine if there was a significant correlation between developmental age and the concept of conservation. To obtain the data needed, thrity primary children from one elementary school were randomly selected and tested with six Piagetian conservation tasks and the Gesell Developmental Examination. The data were collected in April and May 1971. Raw scores for both sets of data were transmuted into ordinal data and statistically compared using rank-order correlational procedures and the test of significance.

The Research Hypothesis

The hypothesis was that if developmental age and the concept of conservation are related, then stages of understanding conservation will increase as developmental age increases.

PROCEDURES

Population

This study was made in Fullerton, a suburban community located in Orange County, California. The Fullerton Elementary School District operated seventeen elementary schools, grades kindergarten through sixth. For three years previous to the study, the primary children at four of these schools were being placed in developmental levels based upon the results of the Gesell Developmental Examination. These levels were arranged sequentially to include the young pre-kindergarten

group (4½ Gesell level), kindergarten (5 Gesell level), pre-first (5½ Gesell level), first (6 Gesell level), pre-second (6½ Gesell level), and the second (7 Gesell level) grades.

Sample

Thirty children for this study came from one of these Gesell-Developmental-Placement-Schools, Rolling Hills School, which had approximately 203 students placed in the Gesell levels 4½ to 6½, on the basis of the Gesell Examination from the previous Spring. The sample consisted of sixteen boys and fourteen girls: five from pre-kindergarten, eight from kindergarten, six from pre-first, seven from first, and four from pre-second. Their chronological age range was 5^{0}_{-} to 8^{10}_{-}.

Methodology

The interview technique on a one-to-one basis was used for both Piagetian conservation tasks and the Gesell Developmental Examination. Conservation tasks were administered by the investigator during April 1971. Gesell Developmental Examinations were administered by one of the six trained teacher-examiners in May 1971.

For the conservation tasks, the investigator chose to replicate tasks described in the literature. In each task, the same procedure was used: the subject was given a brief training to establish familiarity with the material and to develop an understanding of the vocabulary. Then, three transformations of the material were made. Initial equivalence was re-established between each transformation. The subject was asked to quantify the material as being "more" or "the same" and to respond to the question, "Why do you think so?"

or "How can you tell?" after each transformation. Responses were evaluated as "conserving" if the explanation met one of the three criteria established by Piaget: (1) the material had only been lengthened or shortened and could be restored to its original shape; (2) the material had been modified but what if had lost in one dimension it had gained in another; or (3) nothing had been added or taken away. (Piaget, 1957, 16) Responses were considered "non-conserving" if the explanations did not meet one of these criterion. No attempt was made to score responses as transitionary. Each conservation response was scored one and all non-conservation responses were scored zero. The total possible score was eighteen.

The six tasks chosen were centered around the child's concept of conservation of quantity. The term "quantity" is a generic term for materials which can be treated globally and compared in terms of amount. Subclasses of quantity are considered "substance," material massed by nature such as plasticene; "discontinuous quantity," material usually handled in separate parts but which can be massed such as beads; and "continuous quantity," liquid material such as water. (Piaget, 1965, 25-38) The three quantities were presented, first by using one set of tasks and then repeated through a second set of tasks as follows: (1) discontinuous quantity using beads (Piaget, 1960, 25-38); (2) substance using Play-Dough (Elkind, 1968, 11-18); (3) continuous quantity using water (Piaget, 1960, 4-14; and Almy, 1966, 53-54); (4) discontinuous quantity using blocks (Almy, 1966, 51-54); (5) substance using plasticene (Sigen and Hooper, 1968, 19-38); and (6) continuous quantity using orangeade. (Piaget, 1960, 4-14; and

Almy, 1966, 53-54)

The six tasks were tried out in a pilot of study of fifteen children from the same student population as used in the sample. Each subject was seen individually between 8:30 and 11:30 A.M. in a private room. The time for complete testing varied from fifteen to twenty minutes.

For the Gesell Developmental data collection, each subject was seen individually in a private setting. The time for complete testing varied from 30-45 minutes. A fixed order of presentation was used as described by Ilg and Ames: initial interview, paper and pencil tests, right and left tests, form tests, naming of animals, concluding interview, and examination of teething progression. Subject's responses were recorded verbatim and later evaluated by the norms established by the Gesell Institute. (Ilg and Ames, 1968, 31-240). Reliability coefficients were not given by the authors.

The developmental scores on each of the tests were transmuted into ordinal data based upon an arbitrary point system from zero to eight as follows: zero points for each response below four-and-one-half; one point for each 4½-response; two points for each 5-response; three points for each 5½-response; four points for each 6-response; six points for each 7-response; and eight points for each 8-response. The scoring sheet devised by the investigator (Figure 1) shows a contingency table whereby the tests are also given quantitative values. The greatest amount of weight was given to the paper and pencil tests including the imcomplete man, the right and left tests, and the form tests because these sub-verbal tests were most significant in the total developmental evaluation by Ilg

Gesell Developmental Examination
Scoring Form

Child's Name_____Subject_____

Total Score_____

Figure 1.

and Ames. (1964, 34). A total of 320 points was possible.

DATA ANALYSIS

The Spearman Rank-Order Correlation Coefficient and a rank-order correlation coefficient for tied ranks were used to determine the relationship between the developmental scores and the conservation scores. Table I gives a tabular presentation of the data. The Spearman Correlation Coefficient (rho) yielded a value of .555. A correction formula for tied ranks yielded a rho of .549. For the test of significance the lower correlation coefficient of .55 was used and found to be significant at the one-percent level.

Summary

On the basis of the results derived from the rank-order correlation between the developmental scores and the conservation scores, it may be summarized that a relatively high relationship existed between the two variables which was significant at the one-percent level.

DISCUSSION

Implications and Recommendations

1. While the obtained correlation of .55 was strongly positive, it could not be considered high enough to use for predictive purposes between the two instruments. That is, conservation scores would not be used to predict developmental scores and visa versa.

2. It would seem that the Gesell Developmental Examination still appears to be a valid means of determining readiness for developmental levels of learning since it provides not

TABLE I

ESTIMATING THE COEFFICIENT OF CORRELATION BY THE SPEARMAN RANK-ORDER METHOD

N=30
R=rank
D=differences between ranks

$$P = 1 - \frac{6\Sigma D^2}{N(N^2-1)}$$

Subject	Gesell Developmental Raw Score	Piagetian Conservation Raw Score	R^1	R^2	D	D^2
A	153	18	21	5.5	15.5	240.25
B	154	1	19.5	25	5.5	30.25
C	110	1	30	25	5.0	25.00
D	119	0	28	28.6	.6	.36
E	133	0	24	28.6	4.6	21.16
F	124	0	27	28.6	1.6	2.56
G	158	1	16	25	9.0	81.00
H	170	17	11	12.5	1.5	2.25
I	156	18	18	5.5	12.5	156.25
J	165	16	15	15.5	.5	.25
K	130	3	26	21.5	4.5	20.25
L	116	3	29	21.5	7.5	56.25
M	179	18	8	5.5	2.5	6.25
N	173	16	10	15.5	5.5	30.25
O	187	18	5.5	5.5	0	0
P	166	18	14	5.5	8.5	72.25
Q	157	0	17	28.6	11.6	134.56
R	143	17	22	12.5	9.5	90.25
S	141	18	23	5.5	17.5	306.25
T	190	18	4	5.5	1.5	2.25
U	131	2	25	23	2.0	4.0
V	154	.9	19.5	18	1.5	2.25
W	181	17	7	12.5	5.5	30.25
X	174	18	9	5.5	3.5	12.25
Y	167	7	13	19.5	6.5	42.25
Z	169	18	12	5.5	6.5	42.25
AA	187	14	5.5	17	11.5	132.25
BB	201	14	3	12.5	9.5	90.25
CC	216	18	2	5.5	3.5	12.25
DD	230	7	1	19.5	18.5	338.25

N=30

$\Sigma D = 1984.14$

only a cognitive rating, but also indicates the child's total development as suggested by Gesell, Ilg, and Ames.

3. Implicit in Piaget's theory of stage progression is the interaction of maturation, experience, social transmission, and equilibration. If a child does depend upon this interaction to gradually move from a non-conserving stage to a transitionary stage and finally to a conserving stage, then perhaps conservation scores could likewise be used for successful school placement since they, too, would seem to represent the total development of the child. This should be a consideration for future research.

4. If both instruments are considered important to educators, then it would seem that both should be used together until such time as one or the other is proven to be the better predictor of school achievement.

5. It is recommended that the curriculum for primary children even in a developmental-placment school be highly individualized. Although the results of this study gives evidence that there is a trend for children to develop conservation understanding as their developmental age increases, there were some children (DD, Q, I, S, AA) who demonstrated an inconsistent pattern. An assessment of individual readiness for sequential learning tasks within each developmental level continues to be an important consideration to educators.

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